

CLAIMS

1. Method for optically detecting a double feed in an apparatus for processing one or more types of sheet-like objects, particularly banknotes, characterised in that said sheet-like objects are illuminated, a transmission image of a specific sheet-like object of said sheet-like objects is produced by measuring transmission intensities of light transmitted through regions of said specific object and a reflection image is produced by measuring reflection intensities of light reflected from the said regions of said specific object where said double feed is detected by applying a two-dimensional evaluation method, a first dimension of said two-dimensional evaluation method being formed by said transmission intensities and a second dimension of said two-dimensional evaluation method being formed by said reflection intensities, and wherein the two-dimensional evaluation method further comprises determining the location of said points in said two dimensions, and comparing said locations with a linear decision boundary.
2. The method as claimed in claim 1, characterised in that said sheet-like objects are sequentially fed into said apparatus and conveyed along a transport path in a moving direction where first a position and an angle of a specific sheet-like object with respect to said transport path are determined and where second said specific sheet-like object passes a multitude of sensor cells arranged in at least one line being perpendicular to said moving direction, said transmission intensities and said reflection intensities being measured by determining a multitude of sensor values for each sensor cell in fast succession while said specific sheet-like object passes said sensor cells.
3. The method as claimed in claim 2, characterised in that said sheet-like objects are illuminated with infra-red light.

4. The method as claimed in any of claims 2 or 3, characterised in that a set of dedicated test spots is determined for said specific object and said two-dimensional evaluation for said specific sheet-like object
5 is solely carried out for said set of test spots.

5. The method as claimed in claim 4, characterised in that said test spots are defined by image processing said transmission image and said reflection image, thereby considering said position, said angle and known parameters
10 of an object type of said specific sheet-like object.

6. The method as claimed in claim 5, characterised in that said test spots are determined such that they are positioned outside of an exclusion area of said specific object, said exclusion area comprising at least one of the
15 following object areas:

a) an area of said specific object with a dark print, a foil, a hologram or a thread,

b) an area within a given maximum distance to an edge of said specific object or

20 c) an area, particularly a rectangular area, in each corner of said specific object.

7. The method as claimed in any of claims 4 to 6, characterised in that said test spots are grouped in a plurality of overlapping regions of said specific object,
25 where first an independent double feed detection result is determined for each region and second an overall double feed detection result is determined by combining said independent double feed detection results of each region.

8. The method as claimed in any of claims 5 to 7,
30 characterised in that said specific object is validated in a first step and said double feed is detected in a second step only if said specific object has correctly been validated, where said object type of said specific object is determined during said first step of validating said
35 specific object.

9. Apparatus for processing one or more types of sheet-like objects, particularly banknotes, having transport

means for conveying said sheet-like objects along a transport path in a moving direction and a detector for an optical detection of a double feed of said objects, said detector comprising illumination means for illumination of
5 said sheet-like objects, particularly with infra-red light, a transmission-type sensor for producing a transmission image of said objects by measuring transmission intensities of light transmitted through said objects, a reflection-type sensor for producing a reflection image of said
10 objects by measuring reflection intensities of light reflected from said objects and an evaluator which is built such that a two-dimensional evaluation can be carried out where a first dimension is formed by said transmission intensities and a second dimension is formed by said
15 reflection intensities, the evaluator being adapted to carry out the steps of determining the location of said points in said two dimensions, and comparing said locations with a linear decision boundary.

10. Apparatus as claimed in claim 9, characterised in that
20 said illumination means comprise a first elongated illumination unit for illumination of a first surface of said sheet-like objects and a second elongated illumination unit for illumination of a second surface of said sheet-like objects, each illumination unit preferably comprising
25 a multitude of light sources arranged in line.

11. The apparatus as claimed in claim 10, characterised in that said transmission-type sensor comprises an array of sensor cells and said reflection-type sensor comprises an array of sensor cells where said elongated illumination
30 units and said arrays of sensor cells are arranged perpendicular to said moving direction of said transport path.

12. The apparatus as claimed in claim 11, characterised in that each sensor cell comprises a light sensitive device
35 for measuring said intensities of light and optical means, particularly a rod lens, for directing said transmitted or reflected light onto said light sensitive device.

13. Apparatus as claimed in any of claims 11 or 12, characterised in that said detector comprises exactly one array of sensor cells forming said transmission-type sensor as well as said reflection-type sensor and a controller for
5 alternately switching said illumination units on and off and alternately measuring said intensities of light transmitted through or reflected from said sheet-like objects respectively.

14. The apparatus as claimed in any of claims 10 to 13,
10 characterised in that it comprises a validator for a validation of said objects, said validator and said detector being built such that said validation is carried out before said optical detection and such that said optical detection is carried out only if said validation of
15 said objects has been carried out correctly.